CLAIMS

What is claimed is:

1. An arbitrary function generating circuit employing a simple arithmetic circuit element for calculating the following generalized Lotka-Volterra equation (Equation 1),

Equation 1 $$\frac{dx_i}{dt} = x_i\left(r_i + \sum_{j=1}^{m} \mu_{ij} x_j\right) \quad (i = 1, 2, \cdots, n)$$

(x_i is the size of a population i representing the elements of a system; μ_{ij} is a constant of interaction between the elements; and r_i is an intrinsic constant for each element representing the growth rate of the population i;) the arbitrary function generating circuit comprising:

a plurality n of modules, each having a plurality n of input terminals and one output terminal; and

a plurality n of connecting wires including a first connecting wire for connecting the output terminal of the first module to the first input terminal of each module; a second connecting wire for connecting the output terminal of the second module to the second input terminal of each module; and continuing in a like manner until the nth connecting wire for connecting the output terminal of the nth module to the nth input terminal of each module;

each module comprising:

a group of n variable resistors connected to the n input terminals;

an output sum connecting wire connecting the output terminals of the variable resistors to total their output values;

a multiplier having an amplifier for multiplying the total of the output values by the output value from the corresponding module; and

an integrator for integrating the output values.

2. An arbitrary function generating circuit as recited in claim 1, either further comprising interaction constant setting means for programmably changing each value in the group of variable resistors in each module or providing FET semiconductor element circuits as the variable resistors in each module and varying the resistance values in the variable resistors externally using control signals.

3. An arbitrary function generating circuit employing a simple arithmetic circuit element for calculating a generalized Lotka-Volterra equation, the circuit comprising:

a plurality (n) of modules each having one input/output signal terminal, and one signal bus connecting each of the input/output signal terminals;

each module comprising:

a frequency synthesizer;

a first multiplier for multiplying the output from the frequency synthesizer with the value input from the signal bus via the input/output terminal;

a low pass filter for removing the AC component from the

value output by the first multiplier;

a second multiplier into which the output from the low pass filter is input;

an integrator for integrating the output from the second multiplier;

a connecting circuit for inputting the value output from the integrator into the second multiplier, such that the second multiplier can multiply this value with the value output by the low pass filter;

an oscillator; and

a third multiplier connected to the input/output terminal for multiplying the value output by the oscillator with the value output from the integrator.

4. An arbitrary function generating circuit as recited in claim 3, further comprising a means for setting the voltage W_1 with the frequency synthesizer that is provided either external to the module as an amplifying circuit for extracting signals from the internal oscillator and adding weight to the signal or internal to the module as an independent circuit.

5. An arbitrary function generating circuit employing a simple arithmetic circuit element for calculating a generalized Lotka-Volterra equation, the circuit comprising:

a frequency synthesizer that outputs a value W;

a first multiplier that receives the output value W as one input value;

a first low pass filter for cutting out a first frequency component from the value output from the first multiplier;

a second multiplier that receives the value e_4 output from the first low pass filter as one input value;

a second low pass filter that removes a second frequency component lower than the first frequency component from the value output of the second multiplier;

an adder that receives the output value e_5 as one input value;

a delay circuit that delays the output value e_1 and sets the output value e_1 as the second input value to the adder;

a first frequency multiplier that multiplies the frequency of the output value e_1 and outputs an output value e_2 as the second input value for the second multiplier; and

a second frequency multiplier that multiplies the frequency of the output value e_1 and outputs an output value e_3 as the second input value for the first multiplier.

6. An encryption method using an arbitrary function generating circuit according to claim 5, wherein the initial value $e_1|_{t=0}$ of the frequency multiplexed signal e_1 is used as the code to be encrypted and the signal W output from the frequency synthesizer is used as the key code for encryption; and a time change pattern of the signal e_1 or the signal $e_1|_{t=T}$ at a time T is encrypted.

7. An encryption method using an arbitrary function

generating circuit according to claim 5, wherein the signal W output from the frequency synthesizer is used as the code to be encrypted and the initial value $e_1|_{t=0}$ of the frequency multiplexed signal e_1 is used as the key code for encryption; and a time change pattern of the signal e_1 or the signal $e_1|_{t=T}$ at a time T is encrypted.